may be that the final comparison of year with year will furnish a basis for conclusions which will justify the details and labour of these reports.

"The larger waves of migration were not very clearly marked, but there were smaller ones on April 12 and 13, and on May 15. The largest movement occurred on May 2, when no less than twenty-five species arrived simultaneously on our coasts." If these facts are really significant, we naturally wish to see whether they are correlated with weather conditions, and the report, like its predecessors, gives us facilities for speculation on this subject by giving a meteorological summary for each day. Special attention has been paid to the conditions observed over the north coast of Spain, the Bay of Biscay, the coast of France, bounding the Bay, the English Channel, and our southern shores. But the report remains firm in affording us neither countenance nor aid in this speculation. We must wait until the ten years are accomplished before there is any relaxation in the conspiracy of silence, which is a thoroughly scientific procedure.

In saying a moment ago, "if these facts are significant," we were not indulging in a superiority of tone begotten of our own enlightenment on the subject; we simply mean that in the long run the question must be faced whether the net of observation is spread sufficiently widely, and has mesh sufficiently narrow to warrant one in speaking very definitely of waves of different magnitudes, or, in some cases, of waves at all. It is difficult to get rid of the uncomfortable suspicion that what is recorded may be in many cases the exceptional, the normal passing unobserved because there is no one there to see. We wish, therefore, that a large addition to the body of observers throughout England could be secured, so that it might be seen whether a marked narrowing of the mesh is followed by any marked alteration in the general tenor of the records. It may also be that the detailed comparison of one year with another may afford an answer to our difficulty.

There are some interesting remarks in the introduction on the variable length of the immigration period. "The immigration of the wheatear (including both races) extended over a longer period than that taken by any other species, the first arrivals being observed on March 6, the last on May 19. Other species occupying a prolonged period were the willow-warbler (March 19 to May 19) and the whinchat (March 26 to May 23), while the shortest time seems to have been taken by the wood-warbler (April 11 to May 6). The average length of the arrival period for 1910 was about five or six weeks."

We may refer also to the provisional classification of the birds observed into four sets according to their general routes. (*a*) There are those that arrive *solely* on the western half of the south coast—ring-ouzel, pied-flycatcher, and landrail; (*b*) there are those that arrive along the *whole* of the south coast, but first and chiefly on its western half—wheatear, redstart, common whitethroat, garden-warbler, chiffchaff, willow-warbler, spotted flycatcher, swallow, house-martin, sand-martin, and swift; (*c*) there are those that arrive along the *whole* of the south coast, but first and chiefly on its eastern half—whinchat, blackcap, grasshopper-warbler, reed-warbler, nightjar, cuckoo; (*d*) there are those that arrive along the south-east coast, from Essex to Hampshire—nightingale, white wagtail, yellow wagtail, tree-pipit, red-backed shrike, wryneck, turtle-dove. This grouping is still, as we have said, provisional; but there is in it, so to speak, the bud of a generalisation. In some of the items of fact which form the body of the book, there doubtless lurks the beginning of a discovery.

THE POSITION OF TECHNICAL INSTRUCTION IN ENGLAND.

During the last six months or so there have been issued several reports which deal in broad outline with the position of technical instruction in England. The last annual report of the British Science Guild deals with the financial position of higher technical education and with the need for coordination and centralisation of our resources. Attention is directed to the close connection between scientific research and prosperity of national industries, which more and more closely follows the encouragement of scientific investigations. The report of the Imperial Education Conference contained a strong indictment by Mr. J. H. Reynolds, director of higher education for Manchester, of the lack of appreciation of science shown by many political and industrial leaders. The discussion at the Portsmouth meeting of the British Association Section L report on overlapping of educational work brought clearly into view the lamentable truncation of our secondary education, which fails to provide, except in the case of a small minority of pupils, any adequate foundation for higher study of a proper university grade. The Board of Education has quite recently published statistics which emphasise the poor attendance of students at places of higher technical instruction. Readers of Nature are already aware of the main facts; unfortunately they are not sufficiently realised by the general public.

Present Shortcomings.

The essential features of the present position appear to be:—

(1) The low leaving age of secondary schools, and therefore the low standard of entrance into technical schools. The average school life in our secondary schools does not exceed three and a half years, whereas German technical universities require the completion of the full nine years' secondary-school course before admission of fully qualified students.

(2) The preponderance of evening work in English technical institutions. A few evening students are doing amazingly good work under very difficult conditions; but however creditable this may be, and indeed is, to these overworked men and their teachers, it does not seriously affect the following statement in the latest Board of Education report:—"The total amount of advanced instruction of the kind provided in technical institutions is still disappointingly small. In some of the more important industries, as, for example, engineering, the instruction is largely used by students; but in a great many others the supply of students is very small. It is to be deplored that there are several schools in which the well-equipped staffs and the excellent equipment practically stand idle in the daytime through lack of students." There are no evening students at German universities.

(3) The majority of evening students are doing work of a continuation-school character; moreover, for many of them regular attendance is impossible.

(4) Speaking generally, technical teachers are underpaid to a degree which in the long run will surely result in impaired efficiency. Incidentally it may be remarked that the value of the annual production of the German chemical industries alone is about 50,000,000*l*., so that the expenditure by Germany of half a million per annum in excess of England's provision for higher technical instruction yields a good business profit.

(5) Taking the relative populations into account, England stands below the United States, Germany, and Switzerland as regards the training and output of industrial experts having the highest scientific and

technical knowledge. Writing as a chemical manufacturer, Dr. Levinstein warns us against "thinking that we can replace efficient captains by a large number of fairly good corporals."

Interaction between Instruction and Industry.

It will have been observed that engineering holds the best position in the Board of Education review, from which we have quoted, dealing with the technical instruction of the United Kingdom. It is not by accident that British engineers are found all over the world. Any advance in an industry leads to wider and more intense study, to greater demand for instruction, and a consequent improvement in its quality. The loss of the chemical dye industry is frequently attributed to lack of knowledge on the part of English manufacturers. It appears more probable to the writer that the high duty on spirit stifled the industry in its cradle; the loss of the manufacture removed the incentives (moral as well as pecuniary) to study and research from this country, and transferred them to Germany. How the rise of this new German industry promoted study and research into coal-tar derivatives, how this research developed the industry yet farther, and how this reciprocity of industrial and instructional progress has helped the industrial advance of Germany is a story that needs no repetition. But it is still necessary to drive home the importance of close connection between our technical instruction and our industries, and to remove the lost traces of antagonism between the "practical man" and the "theoretical person."

When college training was a new thing, it was to be expected that some of the young men should imagine that their up-to-date theoretical knowledge made them better engineers than their experienced seniors; but such youthful conceit soon finds its Nemesis. By this time many of the managers in engineering works have themselves been through a college course, and the recruit with the ink scarcely dry on his diploma finds his proper level at once. With the realisation of what a college course can, and what it cannot, do towards making a real expert, we may expect an absence of friction and misunderstanding, and the establishment of a right appreciation of college training. There can be no doubt that the United States has profited greatly by not undervaluing courses of study pursued in university institutions. It should not be overlooked that an increase in the number of such trained men raises the status of the nation as a whole. In 1897 there were found to be 7000 chemists trained in Germany holding responsible positions, of whom one thousand were employed in other countries. Deducting another thousand employed in the manufacture of organic compounds—*i.e.* assuming that we do not wish to challenge Germany's supremacy in this department—is it likely that we have 5000 chemists of first-grade qualifications who have been trained in England? It appears probable that we are more nearly forty than fourteen years behind in this respect. The potentialities of our technical institutions are not properly appreciated by chemical manufacturers, and the interaction between industry and instruction is not so free and constant as is requisite for full industrial health.

Some Suggestions towards a Constructive Policy.

A preliminary step would be the limitation of the application of the epithet "technical." The Board of Education should confine the designation "technical institution" to establishments of really advanced staffing and equipment. Elementary classes doing the work of repairing defects in school education should be classed as continuation classes; "technical class" should imply a serious attempt to impart knowledge and skill of a technological character. Stronger efforts should be made to improve the quality of the teaching, both in subject-matter and method, in elementary schools. No boy or girl should leave the elementary school (unless to enter a secondary or trade school) before the age of fourteen. Continuation classes should be available in every locality, as soon as suitable teachers can be obtained, and the recommendations of the Consultative Committee of the Board of Education should be put into practice. In particular employers should liberate young people for a certain number of hours per week in order that they may attend day classes. The leaving age from secondary schools should be raised, and the universities and university colleges should not admit students below eighteen years of age.

Based upon a proper school education in the elementary and continuation schools, trade schools, or secondary schools, evening instruction of great value could be given to the better workmen, foremen, and skilled craftsmen. Such instruction is already given in the polytechnics, in evening classes of university colleges, and in the smaller towns in the technical classes which are frequently styled "institutes." The higher grade of technical instruction should be carried out in the day classes of well-equipped institutions ranking as university colleges. The diploma of these institutes and colleges should deserve recognition as the hall-mark of a trained scientific man. Two years after obtaining his diploma, the holder should be permitted to present a research or thesis to the university, which should grant a degree for work of genuine merit. The approach to such a university degree should not be stopped by protective or revenue-raising barriers of the matriculation type. This demand is made with the idea of preserving the connection which at present exists between departments for higher applied science and the older and modern universities. The alternative would be the adoption of the German system of technical universities. It is by no means certain that these rapidly growing and in some respects very successful universities are models to be followed. There is at least a danger of over-specialisation in the German system—a tendency to produce machine-made men possessing a narrowly specialised knowledge and capacity, but without sufficient width and individuality. Our captains of industry have to control men, as well as to perfect processes.

In the plan roughly outlined above an attempt has been made to provide (*a*) technical education needed by the foreman, skilled artisan, &c., (*b*) technical education needed by the scientific leaders of industry. The former requires a large number of classes of a local character; the country should be peppered with such, and the financing and control should be to a considerable extent the duty of the local education authority. The latter should be large institutions, staffed by specialists, assisted largely by national funds, with centralisation as the dominant idea in their organisation. For both we need advisory boards, including employers and employees, also representatives of the teachers in the schools from which pupils are derived. Provision should be made for the passage of students of exceptional merit from the lower to the higher grade.

Further, it is highly important that greatly increased provision should be made for post-graduate research. Space and opportunity for this work and for carrying on monotechnical courses of an advanced type will be found by freeing the university colleges from the obligation to hold matriculation classes and by relieving our higher technical institutions from the necessity of teaching decimals.

Mr. Reynolds has reminded us that it was in 1869 that Scott Russell wrote "Systematic Technical Education for the English People" in order to "move the minds of English statesmen." Since that date we have nationalised elementary education, and the process of nationalising secondary education proceeds apace. Signs of further realisation of that national organisation of which Sir Norman Lockyer has long been an advocate are to be seen in the Minority Report of the Poor Law Commission and in the recent transfer to the Board of Education of the control of Exchequer grants to universities. The Continued Education Bill introduced by Mr. Runciman fails as a practical measure by reason of the absence of financial provision and of the too-early age for leaving school; but its introduction is welcome as evidence that educated public opinion calls for Governmental action. The London University Commission can scarcely fail to throw light on many of the difficulties which beset the subject. The proposed Teachers' Council will bring together in one national organisation teachers in universities, technical institutions, secondary and elementary schools. All these phenomena afford evidence of an awakening national spirit in matters educational, and the main purpose of this article is to urge all interested to bend their backs to the work of nationalising technical education. By so doing we may advance an important step towards the realisation of Scott Russell's ideal, viz. "to show how to form a nation of well-educated Englishmen, where each workman shall thoroughly know his work; where each foreman shall thoroughly understand the right principles and best methods of executing that work; and where each master of a manufactory, and each member of a profession, shall have received the highest education in the philosophical principles and modern methods of his art, science, or profession." G. F. DANIELL.

ATOMIC WEIGHTS.

THE issue of the Proceedings of the Chemical Society for October 30, vol. xxvii., No. 390, contains the report of the International Committee on Atomic Weights for 1912. At the request of the society the committee wisely acceded to the suggestion that the annual report should be published prior to the beginning of the academic year in order that teachers and students during any given session may not be exposed to the possible inconvenience of having to deal with two sets of numerical values during their lecture or laboratory courses.

There is no doubt that the annual review of the state of contemporary knowledge respecting the values of the fundamental constants known as the atomic weights of the elements acts as a constant stimulus in securing the attention of workers to the importance of the subject; and the critical examination to which the various contributions to the more accurate ascertainment of these values is yearly subjected by the members of the committee tends to raise the standard of what should now be demanded as regards precision and validity of method. The consequence is that all the atomic weights of the commoner elements are now known to a degree of accuracy which stamps these values as among the best determined of all physical constants. They have been ascertained by a great variety of methods and by the use of a great variety of combinations in order to eliminate so far as possible the influence of constant errors. This is especially so in the case of elements such as oxygen, hydrogen, the halogens, nitrogen, carbon, sodium, potassium, silver, &c., which are themselves the bases upon which the determinations of the atomic weights of the other elements ultimately depend.

There is, however, still much to be done before the whole of the atomic weights of the eighty or so elementary bodies are known to this degree of accuracy. In a large number of cases, methods of obtaining suitable combinations of the elements have still to be worked out. It is not always easy to be sure of the purity, individuality, or constancy of composition of such combinations. Methods, too, of quantitative determination may be faulty, or may rest upon a doubtful basis. The efforts of chemists are therefore at the present time mainly directed to attempts to remove these conditions of uncertainty, since they constitute by far the chief sources of error—far greater, indeed, than any uncertainty due to the operation of weighing, for, thanks to the combined efforts of mechanicians and instrument makers, the modern chemical balance, intelligently and skilfully used, if not unsurpassed as an instrument of precision, is fully equal to the demands which modern atomic weights work, at least in its present stage of development, demands of it.

M. J. B. EDOUARD BORNET.

BOTANISTS will learn with regret that the death of the eminent phycologist, M. Edouard Bornet, occurred at Paris on December 18, 1911. Born at Guérigny in 1828, Bornet began by studying medicine, but early in his career turned his attention to cryptogamic botany, and under the direction of Tulasne and Léveillé devoted his energies to the study of algæ and lichens. On this subject, which he continued to pursue throughout his life, he published important papers and memoirs, whilst the garden at Antibes became during his supervision celebrated as a centre of phycological research.

Bornet's work was specially characterised by the care with which he unravelled the life-history of cellular plants, and in his numerous systematic papers the value of this fact is always apparent. His investigations in conjunction with Thuret on the fertilisation of algæ (especially of the Florideæ) were most valuable, and the two large volumes, "Notes Algologiques" and "Études Phycologiques" have been the admiration of all subsequent workers. Bornet also tackled the lichen problem, and the strong support which he gave to Schwendener's views as to the dual nature of these plants led to the early recognition of the accuracy of Schwendener's position. He isolated and specifically determined the algæ which enter into the composition of a large number of lichens, and described the method by which the hyphæ envelop the algæ, as well as the mutual benefit derived from the intimate association of the algæ and fungi. He came to the conclusion that every gonidium of a lichen can be referred to a species of alga, and that the connection of the hypha with the gonidia is of such a nature that it excludes the possibility of one organism being produced by the other. Amongst his systematic works the account of Schousboe's Mediterranean algæ and the joint revision with Flahault of the Nostocaceæ are the most important.

Bornet was "Officier" of the Legion of Honour, and was awarded the gold medal of the Linnean Society in 1891. In 1910 he was elected a foreign member of the Royal Society. British algologists often appealed to Bornet for aid in taxonomic questions, and always found correspondence with him a pleasure, not only on account of his characteristic thoroughness, but by reason of his appreciative interest and unfailing courtesy. A. D. C.